IJWR

TAM-Based Model for Evaluating Learner Satisfaction of E-Learning Services

Case Study: E-Learning System of University of Tehran

Sina Sayardoost Tabrizi[*a], Azin Sabzian[b], Ali Moeini[c], Keikhosrow Yakideh[d]

[a] *Ph.D. of Industrial Management, University of Guilan, Rasht, Iran;* s.sayardoost@ut.ac.ir

[b] *BSc of Computer Engineering, University of Tehran, Kish, Iran;* azin.sabzian@ut.ac.ir

[c] *Professor of Engineering Science Faculty, University of Tehran, Tehran, Iran;* moeini@ut.ac.ir

[d] *Assistant Professor of Management Faculty, University of Guilan, Rasht, Iran;* yakideh@guilan.ac.ir

ABSTRACT

During the COVID-19 pandemic, universities worldwide favored distance learning systems. Although e-learning provides numerous benefits, it also poses challenges for learners, so learners' satisfaction is a significant concern to be assessed. The present study aimed to assess learners' satisfaction with the University of Tehran's LMS during the pandemic. It applied a model based on the Technology Acceptance Model (TAM) and supplemented it with factor analysis. Research validity was assessed by using confirmatory factor analysis, while Cronbach's alpha was employed to measure the reliability of the research instrument. The study used the Partial Least Squares (PLS) analytical method to construct structural equations. In order to do so, data was collected from a comprehensive questionnaire distributed to 334 students at the University of Tehran, in which 143 participated. The findings reaffirmed the TAM's effectiveness in understanding the factors influencing learners' satisfaction with the LMS. Consequently, these insights empower the technical team to enhance system functionality and infrastructure, aiming at improving service quality in the first semester of the academic year 2021. The Results showed that: 1) The TAM-based proposed scale has successfully explained factors predicting learners' satisfaction. 2) Technical knowledge contributes to the perceived ease of use and influences perceived usefulness with a coefficient of 0.89, and 3) The significant relationships between technical knowledge and attitude were met. The paper's contribution is finding that learners' technical knowledge significantly impacts their satisfaction, which helps the ICT team develop a user-friendly environment and increases the flexibility of templates. The study focused on creating training videos to improve learners' technical knowledge. These results can change and improve the software development strategy for the next semester.

Keywords*— *Learners' Satisfaction, Exploratory Factor Analysis, E-Learning Quality, Technology Acceptance Model, Software Development

1. Introduction

The University of Tehran has provided a distance education system called the E-learning management system, which learners can use to attend online classes. E-learning was introduced as one of the learning technologies in which a set of multimedia files combines integrated content. It is shared with the learners. It has provided the possibility of online learning. Many other websites, such as Coursera and Faradars provide online educational content for their applicants. E-learning is fundamentally a web-based program that presents knowledge or information to learners on time, regardless of time constraints or location proximity [1]. Quality in learning could be understood as a set of characteristics or attributes which are chosen for evaluating the service that affects consumer satisfaction, either implicitly or explicitly [2]. The consideration of learner attitudes and opinions in development of web-based systems is a critical factor in enhancing learner satisfaction and improving features, making it one of the most effective software development strategies. This study aims to contribute to the existing body of research by presenting a TAM-Based Model (which is validated based on previous research) and utilizing structural equations and descriptive-survey research methods. The objective is to make a significant contribution to the e-learning development program at the University of Tehran.

2. Related Works

Zethembe Mseleku's research explores the challenges posed by the COVID-19 pandemic in transitioning to online teaching and learning within the educational landscape. The literature identifies several key hurdles, including the struggles of both educators and students to adapt, issues related to connectivity, network, and internet, unsuitable physical spaces and environments, mental health concerns, lack of basic needs, and insufficient teaching and learning resources [3].

The abrupt shift to online learning, driven by the sudden outbreak of COVID-19, left educators with insufficient time to acclimate to new teaching platforms [3]. Learners faced

http://dx.doi.org/10.22133/ijwr.2024.415953.1178

Citation S. Sayardoost Tabrizi, A. Sabzian, A. Moeini, K. Yakideh, " TAM-Based Model for Evaluating Learner Satisfaction of E-Learning Services," *International Journal of Web Research*, vol.6, no.1,pp.105- 112, 2023, doi: http://dx.doi.org/10.22133/ijwr.2024.415953.1178.

*Coressponding Author

Article History: Received: 11 May 2023; Revised: 20 June 2023; Accepted: 23 July 2023.

challenges in adjusting to online learning styles, managing responsibilities at home, and encountered difficulties due to inadequate communication with their instructors, resulting in a general lack of preparedness for online education [4]. Connectivity issues emerged as a primary obstacle, undermining the effectiveness of e-learning and e-teaching during the pandemic lockdown. Additionally, the absence of conducive physical learning spaces posed a challenge, with some learners lacking suitable environments for online education. Kapasia et al. found that 44.4% of students did not have a designated study space, negatively impacting concentration and study productivity [5,6].

While working with an e-learning system, learners' viewpoints about all aspects of learning should be solicited and considered. A descriptive survey and structural equation were used to analyze and identify e-learning success variables in different faculties in [7]. The study looked at 1052 students and found that technology skills, equipment capabilities, learner satisfaction, and motivation all play a role in e-learning readiness. It was demonstrated that motivation has a mediating influence. The findings indicate that vocational education should prioritize improving digital technology capabilities, equipment capabilities, learner satisfaction, and motivation to improve e-learning readiness [7].

In an earlier publication, the case study methodology was successfully applied to an English-language school at the University of Tehran (Kish International Campus). We have incorporated the model from the last paper into the current research based on the effectiveness shown in that research. Thus, validation of the original model's applicability is derived from its successful implementation in a different case study, and the methodologies used in this research are informed by the insights shared in that conference paper. After reviewing the approved model from that article, we shifted our focus to the University of Tehran and the need for a development approach for its e-learning system. This prompted us to gather feedback from our learners, aligning with the established model, to craft a development plan based on research. The objective was to gather valuable input from learners, pinpoint key satisfaction factors, and develop a comprehensive plan to enhance their experience in the upcoming semesters based on their insights. The validation of these papers is based on [8], which was published in 2020.

A study by Ahmad Mohammad Al-smadi, Ahed Abugabah, and Ahmad Al Smadi delves into the elements and factors influencing learners' satisfaction and the quality of e-learning during the COVID-19 era. The findings reveal a lack of promising satisfaction and evaluation of the e-learning experience, prompting a call for higher education institutions to reassess and enhance their efforts in improving the quality of e-learning and learning outcomes. Suggestions include improving IT infrastructure, internet access, and network connectivity to fully support online courses [9].

A cross-sectional study conducted in 2020 at Qazvin University of Medical Sciences, utilizing stratified random sampling, assesses learners' satisfaction with e-learning during the COVID-19 period. Results indicate a mean satisfaction score of 20.75 (standard deviation 2.13), with 59% expressing undesirable satisfaction. Gender and a history of attending online classes before COVID-19 demonstrated a significant relationship with satisfaction levels [9].

Another study during the pandemic investigates the role of technological skills, equipment capabilities, learner satisfaction, and motivation in e-learning readiness. Involving 1052 participants, the study reveals that technology skills, equipment capabilities, learner satisfaction, and motivation significantly contribute to e-learning readiness. The results underscore the importance of enhancing digital technology capabilities, equipment capabilities, learner satisfaction, and motivation in vocational education to strengthen overall readiness [10].

In a study [11], the investigation focused on determining whether learners want to continue to e-learning or return to face-to-face instruction. The Technology Acceptance Model (TAM) was used in the study to examine factors such as perceived usefulness, ease of use, and behavioral intention. A structural analysis was conducted to evaluate the model, with the participation of two hundred and ninety-one learners who responded to a specially designed questionnaire for this study. The results indicated a positive relationship between academic motivation and Behavioral Intention, which is strongly associated with Perceived Usefulness and Perceived Ease of Use. Additionally, factors such as Technical knowledge was found to significantly impact learners' perceptions of usefulness and ease of use which effect on attitude.

In a comprehensive analysis comparing undergraduate and graduate levels at South Korean universities, the study examined the impact of instructor characteristics (attitude, competency, and interaction), learner characteristics (motivation, mindset, and collaboration), and the technology acceptance model (perceived ease of use and perceived usefulness) on learners' behavioral intention to adopt and utilize e-learning in the future. The findings indicated that all factors had a positive influence on learners' behavioral intention to use and embrace the e-learning system during the pandemic. The research underscores the importance of various factors related to learner and instructor characteristics in the acceptance and utilization of this system in the current unavoidable circumstances [12].

3. Proposed Method

3.1. Research Method and Variables

In our analytical method, we collected data through the survey questionnaire for the E-learning system filled out by the learners who used the E-learning management system. The correlation coefficients of the parameters introduced in the proposed model were evaluated to identify the factors affecting the level of learner satisfaction with the E-Learning management system of the University of Tehran. The effect of six factors was investigated as factors affecting learners' satisfaction with the E-Learning management system. The relationships between these factors were presented by a proposed model.

Our proposed model extends a TAM-Model from [8], which has been validated by the results. This paper focuses on higher education and uses PLS-SEM. The TAM-based model in the [8] scale has successfully explained the factors predicting the use of e-learning among Indonesian sports science students during the pandemic. The finding of significant relationships between facilitating conditions and perceived ease of use and between facilitating conditions and perceived usefulness was reported. The relationship between

perceived usefulness and attitude was not found, but there were significant relationships among the core components of TAM.

The collected data has been evaluated based on the Exploratory Factor Analysis method and using structural equations of variance based on SmartPLS software. We employed structural equation modeling and investigated the relationships between the dependent and independent variables, which were effective in evaluating of learner satisfaction [7].

It was necessary to involve a diverse cohort of learners from diverse fields of study in this research because the University of Tehran uses the Learning Management System (LMS) across all faculties and campuses. Therefore, taking into account the diversity of the learner body and the array of academic disciplines, the research was conducted at the Kish International Campus. Based on the findings, it was determined that 143 of 334 active undergraduate learners at the Kish campus participated in the survey. It is noteworthy that, owing to the heightened engagement of undergraduate learners with the system, this demographic constituted the exclusive focus of this research. The sample size equal to 143 was determind with a margin of Error 0.05, P = 0.05, t = 1.65 (Alpha = 0.1), and the N = 300 (nearest value to 334) which is referenced in [14,15]. Based on Krejcie and Morgan Table [16], the number of sample size was strongly satisfied.

In the scope of this research project, our primary objective is to identify key factors influencing the software development program. We aim to explore these factors to enhance the system's structure in future semesters, aligning it with the satisfaction of the learners [17]. The focus is on understanding the elements that contribute to an improved learning experience in software development [18]. This issue can be classified as a knowledge gap. In this paper, we aim to identify effective factors in learner satisfaction based on a TAM-model confirmed by previous research. Our goal is to help design a software development program that prioritizes increasing learner satisfaction in the E-Learning system (LMS) of the University of Tehran.

TAM-Based Model

In the TAM-based model (Technology Acceptance Model), the attitude variable expresses people's opinions of using this system, which indicates the level of their understanding of the ease of use and the level of perceived usefulness of this system [19]. Additionally, the usefulness of using the system directly impacts learners' behavioral performance in working with the E-Learning system. Moreover, the facilitating conditions have been an effective factor in the perceived usefulness for students. This is because the more facilitating conditions are provided for the learners, the more useful the system would be for them; Also, the learners who have higher technical knowledge can use the system more easily. This shows that the learners' technical knowledge level has been an effective factor in understanding the learner's ease of use of the system.

In this paper, the Perceived Ease of Use and Perceived Usefulness of the system are considered to have a major effect on the Behavioral Intention of the learners. This Behavioral Intention of the learners would highly affect the level of learner satisfaction with the system in the time of Coronavirus.

3.2. Proposed Model and Hypothesis

To evaluate the level of learner satisfaction with the e-learning management system, the performance of this system has been investigated at the University of Tehran. In this scenario, the TAM model according to Figure 1 has been used as the proposed model. In this proposed model, Perceived Ease of Use and Perceived Usefulness are introduced as two effective factors in the Behavioral Intention of the learners. The Facilitating Conditions of the E-learn management system Indicates the facilities and conditions of the helper to introduce and teach the learners how to use the system. Our proposed model extends the TAM model referenced in [8]. Our questionnaire is an extension of [8], including additional technical knowledge and an extra link. The validity and reliability of the proposed model are consistent with our previous research.

According to Figure 1, hypothesis 1 (H1) is defined as follows: facilitating conditions have a relationship with the perceived usefulness, and according to hypothesis 2 (H2), these facilitating conditions affect the understanding the ease of use of the system. In the same way, we define that hypothesis 3 and 4 (H3 and H4) show that the learners' technical knowledge level has a major effect on the understanding of the ease of use and attitude. Moreover, he relationship between the perceived ease of use with the perceived usefulness and attitude are shown as H5 and H6. The relationship between the perceived usefulness and the person's attitude, which includes his/her positive or negative feelings toward the system, is considered hypothesis 7 (H7), and the relationship between perceived usefulness and behavioral intention is considered as hypothesis 8 (H8), which of course is considered as a correlation between those two factors. The nesting of these factors was examined and analyzed. Also, the relationship between attitude and behavioral intentions has been considered as hypothesis 9 (H9). Finally, the effect of behavioral intentions on the target factor, which was the learner satisfaction level in using the system during the Corona pandemic, has been considered as hypothesis 10 (H10). Overall, 10 hypotheses were introduced and reviewed in this study, and all of them were introduced to check the level of learner satisfaction. (Figure.1)

Data collection

In this research, SmartPLS software was used to evaluate the proposed model's factor loadings and measure each factor's impact. Also, a questionnaire has been used that presents the factors affecting the TAM-based model. In this study, 138 learners of the University of Tehran were participated and filled out the survey questionnaire. These learners are in a wide variety of age ranges and they have relatively different backgrounds. This makes our proposed model more reliable in this research. These students are studying in the fields of art, human sciences, engineering, and medical sciences and have bachelor's, master's, and doctoral degrees.

In this paper, a questionnaire with 25 questions and also a Google Form service were used to collect data. Our goal is to provide a model based on which we can estimate the level of learner satisfaction. The collected data was implemented with CSV File and then after preparation was used as input in SmartPLS software.

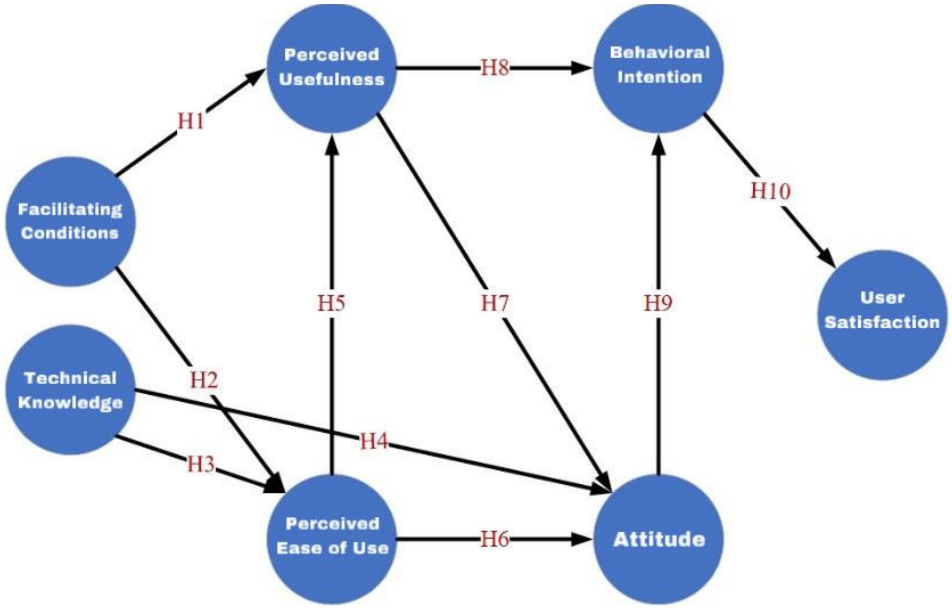

Figure. 1. Proposed Model and all Hypothesis (Extended from [8])

4. Evaluation

This questionnaire evaluates the target community of this field study by considering 29 key indicators in addition to 6 analytical questions. In the structural model (Figure.2) obtained from the software, 7 reflective structures are introduced, and each key index is considered as a subset of these structures. As shown in Figure 2, three indicators, FC1, FC2, BI4, SUE4 and TK4, have been removed from the model due to their low correlation with their observed variable, to obtain the best result from the path coefficients. Finally, the number of key indicators was reduced to 24. In the structural model shown in Figure 2, if the obtained each number estimated from correlations between variables was greater than 1.96, it shows a significant level of correlation between the variables of the structure. As the results obtained from Table 1 and Figure 3, the average variance extracted (AVE) for all constructs was calculated to be higher than 0.5, which describes the accuracy of measuring the variables and the reliability of the proposed model.

By examining the effect of factor loadings and the degree of correlation between observed and latent variables, as well as measuring the combined reliability and validity of the proposed model [20], a reliable output is obtained (as shown in Table 1). The measurement of factor loadings shows the degree of correlation of each construct with itself as well as the convergence between the constructs, this convergence has been measured by considering Cronbach's alpha and composite reliability [20]. In Table 1, Cronbach's alpha value is 0.86 for the latent variable of attitude and the composite reliability value is 0.91 for the latent variable of perceived ease of use. As can be seen in Figure 2, the proportional validity criterion obtained from this proposed model shows the internal consistency as well as the strength of the relationship between the indicators in the proposed model.

4.1. Discriminant Validity

After collecting the data, it is time to measure the validity of the data. Validity means that the researcher's tool can accurately evaluate the subject being measured. Construct validity is classified into two parts: divergent and convergent

Table 1. Construct Reliability and Validity

Latent VAR	*Observed Variable*	*Factor Loading*	*Cronbach's α*	*Composite Reliability*	*AVE*
Technical Knowledge	TK1 TK2 TK3 TK5	0.741 0.888 0.873 0.861	0.86	0.91	0.71
Perceived Ease of Use	PEU1 PEU2 PEU3 PEU4	0.895 0.838 0.825 0.836	0.87	0.91	0.72
Learner Satisfaction	SUE1 SUE2 SUE3	0.895 0.895 0.895	0.88	0.92	0.80
Perceived Usefulness	PU1 PU2 PU3 PU4	0.910 0.872 0.910 0.917	0.92	0.95	0.81
Facilitating Conditions	FC3	1.000	1.00	1.00	1.00
Behavioral Intention	BI1 BI2 BI3 BI5	0.956 0.958 0.969 0.871	0.95	0.97	0.88
Attitude	AT1 AT2 AT3 AT4	0.906 0.823 0.890 0.723	0.86	0.90	0.70

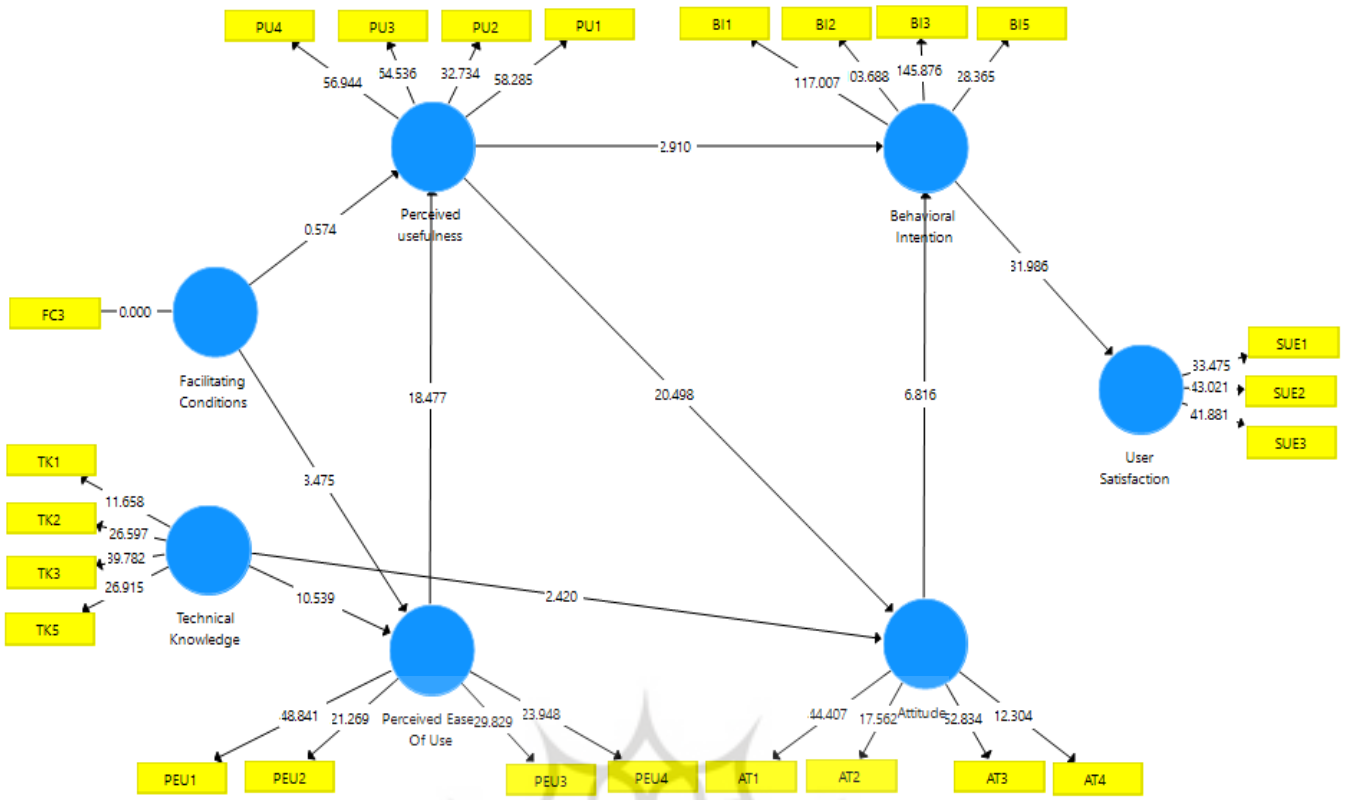

Figure. 2. Results of Structural Model.

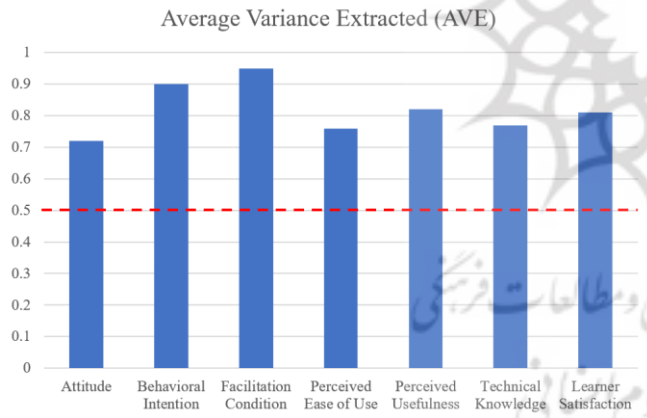

Figure. 3. Average Variance Extracted Results

validity. According to Fornell Larcker's report shown in Table 2 (attached end of the paper), the value of validity obtained from the proposed model for each construct should be less than the variance of the total constructs. Table 2 shows a triangular matrix, the values in the diameter of this triangular include a larger value than the number shown in each row. It indicates that in this study there is a proportional validity between the observable variables and their latent variables. Also, this validity shows us favorable results when the factor load of an index in one construct is more than in other constructs.

After collecting the data, it is time to measure the validity of the data. Validity means that the researcher's tool can accurately evaluate the subject being measured. Construct validity is classified into two parts: divergent and convergent

validity. According to Fornell Larcker's report shown in Table 2 (attached end of the paper), the value of validity obtained from the proposed model for each construct should be less than the variance of the total constructs. Table 2 shows a triangular matrix, the values in the diameter of this triangular include a larger value than the number shown in each row. It indicates that in this study there is a proportional validity between the observable variables and their latent variables. Also, this validity shows us favorable results when the factor load of an index in one construct is more than in other constructs.

As Cross loading calculation, the factor load of each index for each construct shows the highest value compared to other constructs, which shows the correctness of the correlation of Observable and latent variables in this proposed model. Additionally, From the results that obtained from the SmartPLS, differential validity is significant when their values are higher than 0.9. To evaluate the path coefficients between observed and latent variables, a bootstrapped algorithm with 5000 samples and a significance level of 5% was used the results of which can be seen in Table 3 (path co-efficiency). Table 3 shows the relationship between the two independent variables that are connected and the 10 hypotheses of this paper, which were introduced according to

Figure 1, and was investigated by the T-Test, and its p-value was reported. As the results show in Table 3, Samples with a P-value less than 0.05 or a T-statistic value greater than 1.96 have a significant relationship. If the calculated values for these two parameters do not fall within this range, there is not a significant relationship between the two independent variables in the proposed model.

Table 2. Fornell Larcker Results

	AT	*BI*	*FC*	*PEU*	*PU*	*TK*	*US*
Attitude	**0.839**						
Behavioral Intention	0.869	**0.939**					
Facilitating Conditions	0.330	0.262	**1.000**				
Perceived Ease of Use	0.755	0.705	0.423	**0.849**			
Perceived Usefulness	0.869	0.826	0.311	0.800	**0.903**		
Technical Knowledge	0.543	0.500	0.305	0.689	0.507	**0.843**	
Learner Satisfaction	0.828	0.847	0.359	0.825	0.836	0.673	**0.895**

Table 3. Path Co-Efficiency Results

Co-efficiency	*Original Sample (O)*	*Sample Mean (M)*	*Standard Deviation (STDEV)*	*T Statistics (|O/STDEV|)*	*P Values*	*Significant*
Attitude => ***Behavioral Intention***	0.62	0.62	0.09	6.82	0.00	**Yes**
Behavioral Intention => ***Learner Satisfaction***	0.85	0.85	0.03	31.99	0.00	**Yes**
Facilitating Conditions => ***Perceived Ease of Use***	0.23	0.23	0.07	3.47	0.00	**Yes**
Facilitating Conditions => ***Perceived Usefulness***	0.00	0.00	0.06	0.57	0.57	**No**
Perceived Ease of Use => ***Perceived Usefulness***	0.81	0.81	0.04	18.48	0.00	**Yes**
Perceived Usefulness => ***Attitude***	0.80	0.80	0.04	20.50	0.00	**Yes**
Perceived Usefulness => ***Behavioral Intention***	0.29	0.29	0.10	2.91	0.00	**Yes**
Technical Knowledge => ***Attitude***	0.14	0.14	0.06	2.42	0.02	**Yes**
Technical Knowledge => ***Perceived Ease of Use***	0.62	0.62	0.06	10.54	0.00	**Yes**

4.2. Determination factor R^2

This coefficient can be used to measure the prediction accuracy of the proposed model. The value of this coefficient can be predicted by the observed variable in examining the relationship between observed and latent variables. This coefficient is the output value of the regression analysis, which is used as the variance ratio between the latent variables. This coefficient can also be defined as the square of the correlation coefficient between the variables. The values of this coefficient can be between zero and one. In Table 4, R^2 coefficients belonging to the variables of the proposed model are prepared. As shown in Table 4, if the value of this coefficient is less than 0.25, it indicates a weak correlation between the variables, if it is in the range of 0.25 to 0.75, it indicates an average correlation, and finally, if the value of the coefficient is more than 0.75, it indicates a strong correlation between the structure variables.

Table 4. R Square Calculation

	R Square	*Correlation*
Attitude	0.769	STRONG
Behavioral Intention	0.776	STRONG
Perceived Ease of Use	0.525	AVERAGE
Perceived Usefulness	0.641	AVERAGE
Learner Satisfaction	0.717	AVERAGE

4.3. F Square Effect size

This statistical parameter can be used to measure the accuracy of the relationship between observed and latent variables. According to the proposed model, 10 relationships between latent variables have been reported, and the values of the F^2 effect size are given in the SmartPLS. The sum of these values indicates the amount of this effect in terms of the variables, which finally reported the results obtained for this parameter with proper accuracy.

5. Conclusion and Discussion

Before this article, the model had been approved for studying an English language school case study [19,8]. After confirming its validity, we utilized the model to measure learner satisfaction at the University of Tehran. For this purpose, we conducted a survey among learners from different fields to investigate the factors that affect their satisfaction. The results in the Table 2 and Table 3 confirmed the relationships between the dependent variables and shows the authenticity of our research.

In this study, we designed a questionnaire tailored for students of Tehran University's Learning Management System (LMS) to investigate the influence of six key factors on learner satisfaction. Specifically, we examined Attitude, Behavioral Intentions, Perceived Usefulness, Facilitating Conditions, Technical Knowledge, and Perceived Ease of Use as variables affecting learner satisfaction and presented their interrelationships through a proposed model. Employing SmartPLS software for evaluation, we confirmed the appropriateness of the randomly selected sample size and assessed the variable loadings of the proposed model.

Our findings, based on the Technology Acceptance Model (TAM) and E-Learning Quality (ELQ) models, demonstrated that the structural model accurately identified the significant factors impacting learner satisfaction within the context of our professorship at the University of Tehran's E-Learning management system. It is crucial to note that these results may differ for other universities due to variations in electronic education systems and diverse backgrounds and fields of study among the audience at each institution.

Our model effectively determined the influential parameters in learner satisfaction, emphasizing its potential applicability to other universities. However, it is

acknowledged that the coefficients of influence for these parameters in the proposed model may vary across different educational institutions.

A key highlight of this research is the emphasis on factors with high factor loadings, revealing that behavioral intention serves as a mediator between attitude and learner satisfaction. Furthermore, considering the impact of technical knowledge on attitude, it can be concluded that the technical knowledge possessed by each learner significantly affects their satisfaction levels while engaging with e-learning services [8].

As part of future research endeavors, this model can be applied to other universities for comparative analysis, enabling insights and conclusions to be drawn across Iranian educational institutions. Additionally, there is potential for further development by expanding the indicators within the proposed model to enhance its comprehensiveness and applicability. The visual features and UI attractiveness of the LMS can significantly impact learner satisfaction. Evaluating the system's quality based on the SERVQUAL standard and combining it with the TAM-Based model may represent the future of this research path. The investigation highlighted the importance of prioritizing technical knowledge and awareness when approaching the Learning Management System using the proposed conceptual TAM-model, in comparison to related approaches [5]. This factor should be considered essential for future modeling endeavors. “

Declarations

Funding

This research did not receive any grant from funding agencies in the public. Commercial, or non-profit sectors and the authors didn’t receive support from any organization.

Authors' contributions

SST: Design, interpretation of the results, drafting the manuscript and revision.
AS: Study design, acquisition of data and drafting the manuscript.
AM: Supervision, Interpretation of the results and final revision.
KY: Supervision, statistical analysis and final revision

Conflict of interest

The authors declare that they have no conflict of interests.

References

[1] A. Mayburd, "A public-private partnership for the express development of antiviral leads: a perspective view," *Expert Opinion on Drug Discovery*, vol. 16, no. 1, pp. 23-38, 2021.

[2] V. M. MR, B. Rajakumar, D. Binu, and P. Ramesh, "Analysis on Quality of Learning in e-learning Platforms," *International Journal of Engineering Education*, vol. 3, no. 2, 2022.

[3] Z. Mseleku, "A literature review of E-learning and E-teaching in the era of Covid-19 pandemic," *ed: Sage Los Angeles*, CA, USA:, 2020.

[4] R. E. Baticulon et al., "Barriers to online learning in the time of COVID-19: A national survey of medical students in the Philippines," *Medical science educator*, vol. 31, pp. 615-626, 2021.

[5] N. Kapasia et al., "Impact of lockdown on learning status of undergraduate and postgraduate students during COVID-19 pandemic in West Bengal, India," *Children and youth services review*, vol. 116, p. 105194, 2020.

[6] C.-L. Chang and M. Fang, "E-Learning and online instructions of higher education during the 2019 novel coronavirus diseases (COVID-19) epidemic," *in Journal of Physics: Conference Series*, 2020, vol. 1574, no. 1: IOP Publishing, p. 012166.

[7] M. J. Shayegan and A. Ashoori, "Evaluating Success of E-Learning in Different Faculties of a University," *International Journal of Web Research*, vol. 5, no. 2, pp. 61-69, 2022.

[8] S. Sukendro et al., "Using an extended Technology Acceptance Model to understand students’ use of e-learning during Covid-19: Indonesian sport science education context," *Heliyon*, vol. 6, no. 11, 2020.

[9] A. M. Al-Smadi, A. Abugabah, and A. Al Smadi, "Evaluation of E-learning Experience in the Light of the Covid-19 in Higher Education," *Procedia Computer Science*, vol. 201, pp. 383-389, 2022.

[10] W. Wagiran, S. Suharjana, M. Nurtanto, and F. Mutohhari, "Determining the e-learning readiness of higher education students: A study during the COVID-19 pandemic," *Heliyon*, vol. 8, no. 10, 2022.

[11] M. O. Alassafi, "E-learning intention material using TAM: A case study," *Materials Today: Proceedings*, vol. 61, pp. 873-877, 2022.

[12] H. Baber, "Modelling the acceptance of e-learning during the pandemic of COVID-19-A study of South Korea," *The International Journal of Management Education*, vol. 19, no. 2, p. 100503, 2021.

[13] M. Wotto, "The future high education distance learning in Canada, the United States, and France: Insights from before COVID-19 secondary data analysis," *Journal of Educational Technology Systems*, vol. 49, no. 2, pp. 262-281, 2020.

[14] H. Ahmad and H. Halim, "Determining sample size for research activities," *Selangor Business Review*, pp. 20-34, 2017.

[15] C. C. Higgins and J. W. Kotrlik, "Selecting an Appropriate Sample Size for Conducting Survey Research," in *TITLE Delta Pi Epsilon National Conference. Book of Readings (Nashville, Tennessee, November 15-17, 2001). INSTITUTION Delta Pi Epsilon Society, Little Rock, AR.*: ERIC, p. 136.

[16] R. Hill, "What sample size is “enough” in internet survey research," *Interpersonal Computing and Technology: An electronic journal for the 21st century*, vol. 6, no. 3-4, pp. 1-12, 1998.

[17] M. Andarwati, D. Zuhroh, and F. Amrullah, "End user satisfaction of accounting information system (AIS) mobile based for small medium enterprises (SMEs): Actual usage and TAM approach," *Journal of Development Research*, vol. 3, no. 2, pp. 37-42, 2019.

[18] M. a. Sholikah and S. Sutirman, "How Technology Acceptance Model TAM) Factors of Electronic Learning Influence Education Service Quality through Students' Satisfaction," *TEM Journal*, vol. 9, no. 3, p. 1221, 2020.

[19] A. Almanthari, S. Maulina, and S. Bruce, "Secondary School Mathematics Teachers' Views on E-Learning Implementation Barriers during the COVID-19 Pandemic: The Case of Indonesia," *Eurasia journal of mathematics, science and technology education*, vol. 16, no. 7, 2020.

[20] J. F. Hair, J. J. Risher, M. Sarstedt, and C. M. Ringle, "When to use and how to report the results of PLS-SEM," *European business review*, vol. 31, no. 1, pp. 2-24, 2019.

Sina Sayardoost Tabrizi is a Ph.D. Candidate of Industrial Management at University of Guilan. He has received a Master of Computer Engineering from ECE Department at the University of Tehran in 2015. He is Lecturer and Head of E-Learning Services at University of Tehran Kish International Campus since 2017. His research interest are Data Science, Machine Learning, Data Envelopment Analysis, Supply chain, Computer architecture and Network-on-Chips (NoC).

Azin Sabzian is a prospective researcher and graduated student from the University of Tehran. She received her bachelor's degree in Computer Engineering from the University of Tehran in 2023. Her research interests are Data Science and Machine Learning.

Dr. Ali Moeini is a Full Professor at the School of Engineering at the University of Tehran. He is also dean of Faculty of Engineering Sciences at the University of Tehran. He has received his Ph.D. in Nonlinear Systems at the University of Sussex, UK, in 1997. His research interests include Data mining, online computation and competitive analysis, soft computing methods, randomized algorithms, approximation algorithms, and bioinformatics.

Dr. Keikhosrow Yakideh is an Assistant Professor at Department of Management at the University of Guilan. He is also director of Management group at the University of Guilan. He has received his Ph.D. degree in Industrial Management at the University of Tehran. His research interests are Data Envelopment Analysis, operational research, Supply chain management, Statistical analysis and Mathematics.